

Gas-Kinetic Computational Algorithms for Hypersonic Flows in Continuum and Transitional Regimes, Phase I

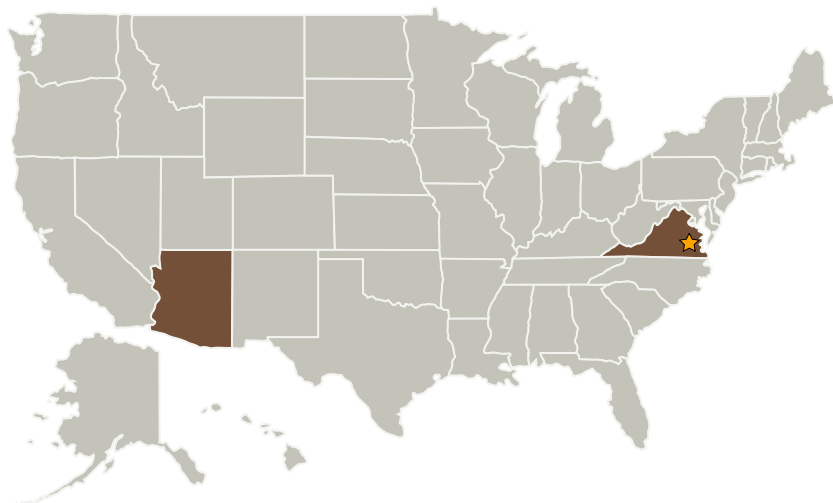
Completed Technology Project (2008 - 2008)



Project Introduction

This SBIR Phase I project explores two gas-kinetic computational algorithms for simulation of hypersonic flows in both continuum and transitional regimes. One is the gas-kinetic BGK-Burnett solver and the other is the gas-kinetic BGK solver with the regulated particle collision time. Different from the macroscopic Burnett approach, the proposed gas-kinetic BGK-Burnett solver is unconditionally stable for all Knudsen numbers. Whereas it is almost impossible to correctly set up boundary condition for the Burnett equations, this can be easily done in the proposed BGK-Burnett solver with the Maxwell boundary condition, re-emitting the particles from the boundary according to the accommodation coefficient. More importantly, this BGK-Burnett solver not only allows a single algorithm for both continuum and transitional flow regimes but also is more suitable for integration with either DSMC or direct Boltzmann solver in the rarefied flow regime. The gas-kinetic BGK solver with the regulated particle collision time can further reduce the computational costs over the BGK-Burnett solver. The focus of Phase I work is to determine the validity Knudsen number range of these two algorithms.

Primary U.S. Work Locations and Key Partners



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Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Organizational Responsibility	1
Project Management	2
Technology Areas	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia
D&P, LLC	Supporting Organization	Industry	Phoenix, Arizona

Primary U.S. Work Locations

Arizona	Virginia
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Lei Tang

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
 - └ TX17.5 GN&C Systems Engineering Technologies
 - └ TX17.5.2 GN&C Fault Management / Fault Tolerance / Autonomy